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RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(88) Date of publication of the international search report:

16 November 2023 (16.11.2023)

(54) Title: VACCINES AND RELATED METHODS

(57) Abstract: Provided herein are SARS-CoV-2 spike proteins and polypeptides (e.g., SARS-CoV-2 spike proteins and polypeptide immunogens (and immunogenic fragments and immunogenic variants thereof)) comprising at least one set of amino acid substitutions, and nucleic acid molecules encoding the same. Further provided herein are compositions (e.g., pharmaceutical compositions) and vaccines comprising the same for use in e.g., the prevention, treatment, and/or amelioration of a SARS-CoV-2 infection.



WO 2023/196634 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2023/017945

A. CLASSIFICATION OF SUBJECT MATTER INV. A61K39/12 A61P31/14 C07K14/005 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A61K A61P C07K C12N		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, Sequence Search, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	LEE CHERYL YI-PIN ET AL: "Human neutralising antibodies elicited by SARS-CoV-2 non-D614G variants offer cross-protection against the SARS-CoV-2 D614G variant", CLINICAL & TRANSLATIONAL IMMUNOLOGY , vol. 10, no. 2 1 January 2021 (2021-01-01), XP093018887, GB ISSN: 2050-0068, DOI: 10.1002/cti2.1241 Retrieved from the Internet: URL:https://onlinelibrary.wiley.com/doi/full-xml/10.1002/cti2.1241 *** abstract *** ----- -/--	1-92
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
9 August 2023		17/10/2023
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Heder, Andreas

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2023/017945

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DATABASE EMBL [Online] 9 February 2022 (2022-02-09), "Severe acute respiratory syndrome coronavirus 2 partial surface glycoprotein", XP002809863, retrieved from EBI Database accession no. UJR88270 sequence -----	1-92
A	WO 2021/243122 A2 (UNIV TEXAS [US]; DARTMOUTH COLLEGE [US]) 2 December 2021 (2021-12-02) -----	1-92
A	CHAUDHARY NAMIT ET AL: "mRNA vaccines for infectious diseases: principles, delivery and clinical translation", NATURE REVIEWS DRUG DISCOVERY, NATURE PUBLISHING GROUP, GB, vol. 20, no. 11, 25 August 2021 (2021-08-25), pages 817-838, XP037602785, ISSN: 1474-1776, DOI: 10.1038/S41573-021-00283-5 [retrieved on 2021-08-25] *** Table 2, Figures 1, 2, Refs. 25, 54 ***; lines 1-92 -----	1-92

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2023/017945

Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of a sequence listing:
 - a. ☒ forming part of the international application as filed.
 - b. ☐ furnished subsequent to the international filing date for the purposes of international search (Rule 13*ter*.1(a)).

☐ accompanied by a statement to the effect that the sequence listing does not go beyond the disclosure in the international application as filed.
2. ☐ With regard to any nucleotide and/or amino acid sequence disclosed in the international application, this report has been established to the extent that a meaningful search could be carried out without a WIPO Standard ST.26 compliant sequence listing.
3. Additional comments:

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2023/017945

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:
1-92 (partially)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-92 (partially)

Nucleic acid coding for SARS-CoV-2 Spike protein variant, SARS-CoV-2 Spike protein variant, conjugate, carrier, vaccine and pharmaceutical compositions, and kit comprising the same, medical use thereof, wherein said variant has the first-mentioned substitution, I28Y, according to Table 2

2-1927. claims: 1-92 (partially)

Like invention 1, but wherein said variant having the 2nd-1927th substitution according to Table 2

1928. claims: 1-92 (partially)

Group of inventions, like invention 1, wherein said variant has a substitution not mentioned Table 2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2023/017945

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2021243122 A2	02-12-2021	AU 2021279079 A1	15-12-2022
		BR 112022023591 A2	27-12-2022
		CA 3180554 A1	02-12-2021
		CN 116802193 A	22-09-2023
		EP 4157345 A2	05-04-2023
		IL 298131 A	01-01-2023
		JP 2023527556 A	29-06-2023
		KR 20230018394 A	07-02-2023
		US 2023242594 A1	03-08-2023
		WO 2021243122 A2	02-12-2021
